



3<sup>rd</sup> International Congress on

## Civil Engineering, Architecture, Building Materials and Environment

November 28, 2023 Helsinki, Finland

# Risk management: The factors affecting civil engineering and construction process

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## Abstract

Globalization and technological turbulence increase uncertainty and risk, which leads to the pressure on engineering and businesses. In addition, worldwide, technology change and risk, disaster risk and climate change are emerging topics. The presence of risk exists in all human activities and systems which means it is an inevitable part of business, and in many areas, it is necessary to provide confirmation of the implementation of appropriate risk management processes, especially considering the volume of data that is provided and processed in business processes. The purpose of this research is to identify the factors which may have positive effects on risk management in civil engineering. Three civil engineering specialists were chosen for interviews for a study on risk management issues in construction engineering. In this research, 15 engineering, 6 external, 18 internal, and 8 organizational and managerial aspects of risk management have been identified through interviews. The research results have identified the main causes of accidents that may pose a risk. The identification of these factors can be used in order to formulate a strategy for the selection of civil engineers, construction technology, construction materials, employers, and contractors, as well as insurance companies.

**Key words:** Risk management, civil engineering, external risk, internal risk, organizational and managerial risk



## 1. Introduction

In recent decades, there has been a great deal of interest in managerial characteristics and corporate success (Chakabva and Tengeh, 2023). Risk management is one of the interdisciplinary and widely taught subjects in business and engineering. Furthermore, interaction with the scientific, technological, and societal communities improves this field (Guntzburger et al., 2016). As a result, the issue of risk is addressed in a consistent way across disciplines. Globalization and technological disruption raise uncertainty and risk, putting additional strain on engineering and businesses. Moreover, worldwide, technology change and risk, disaster risk, and climate change are emerging topics. The quality of our physical environment is under increasing pressure due to grand challenges such as climate change, future energy and water supply, and a new set of policy goals on themes such as sustainability and circularity (Lenderink et al., 2022).

The societal and environmental effects of the profession are of particular interest to the discipline of engineering ethics. This topic is covered in many research through macro-ethical considerations (Guntzburger et al., 2016). Risk is present in all human systems and actions. Since risk is an inherent component of business, it is frequently required to certify that the proper risk management procedures have been implemented, especially in light of the volume of data that is delivered to and processed by business processes (Stojičić et al., 2023). As human knowledge and technology advancements increase, so do societal demands. As a result, the projects being worked on tend to be big and increasing bigger as well as complicated and multidisciplinary (Baker et al., 1999).

The requirement to actively manage the development process and the risks associated with this innovation increases as the size of change and complexity of developing an innovation both rise (Lenderink et al., 2022). This uncertainty over the system's performance in the future also rises (Lenderink et al., 2022). In engineering projects including the planning of actions to increase safety and prevent possible loss of life or property, risk assessment and management are frequently present. In order to qualify a risk, risk assessment typically comprises methods for identifying threats as well as qualitative and quantitative risk analysis (Stojičić et al., 2023). As a result, risk management is a crucial tool for managers to use in their businesses to help them make the best decisions possible (Rampini et al., 2019). As a result, organizations develop policies to help execute risk management.

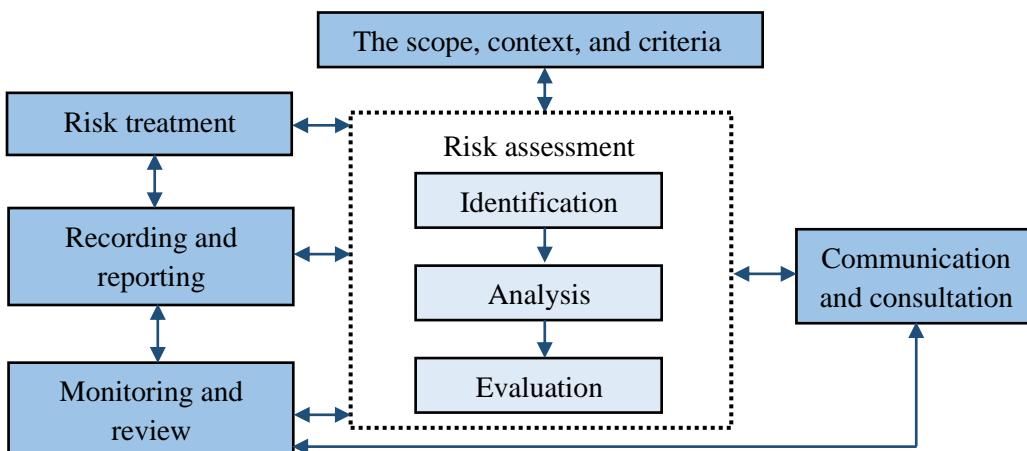
In this respect, risk management should be viewed as a practical strategy, included into a strategic plan that managers really implement, while taking into consideration the specificities of the internal and external organizational environments and being diligent in monitoring (Rampini et al., 2019). According to Micán Rincón et al. (2023), there is a definite tendency toward conducting extensive studies of potential risks, taking into account both internal and external elements, and prioritizing early identification and assessment throughout the project and management process. Due to the presence of risks in all activities and areas of life, as well as the high potential of material, energy, and economic aspects of production systems the scope and severity of the consequences, risk management requires special attention (Stojičić et al., 2023). The purpose of this research is to identify factors that



may have positive effects on risk management in civil engineering. The data have been collected and analyzed through a qualitative method. Identifying these risks can reduce the costs and waste of time in the construction of projects and minimize the insurance premium damage claims from the insurance companies.

## 2. Risk management

Risk management is primarily concerned with maximizing system stability and achieving corporate objectives while reducing losses and the repercussions of unfavorable events (Stojičić et al., 2023). The chance of an effect, the uncertainty of an outcome, or an event with a negative impact or outcome are all examples of risk (Lenderink et al., 2022). Unwanted events can lead to harmful situations and can be assessed from a variety of perspectives, including event analysis, analysis of existing unsafe conditions, and analysis of potential occurrences of unsafe conditions. Design, construction, constructing, and maintenance of facilities and technological systems are examples of areas where unsafe situations can be noticed, leading to the occurrence of unwanted events (Stojičić et al., 2023). Risk is defined by Parviainen et al. (2021) and Lenderink et al. (2022) in accordance with ISO 31000 as the impact of uncertainty on goals. According to Parviainen et al. (2021), the phrase refers to the unpredictability and gravity of the results (or consequences) of an action in relation to something that humans value. According to Stojičić et al. (2023), the ISO 31000 standard offers firms recommendations on how to incorporate "risk-based" decision-making into the organization from the perspectives of management, planning, management, reporting, directing policies, values, and cultures. According to ISO 31000, Parviainen et al. (2021) claim that the risk management process is considered an iterative process, including the following steps: 1) defining the scope, context, and criteria; 2) risk assessment (including risk identification, risk analysis, and risk evaluation); 3) risk treatment; 4) recording and reporting; 5) monitoring and review; and 6) communication and consultation. Figure (1) demonstrates risk management process according to ISO 31000 and Parvianinen (2021).



**Figure 1:** Risk management process

A significant project's success depends on the five stages of risk management, according to Baker et al. (1999) and Stojičić et al. (2023). Identification, analysis, evaluation, response,



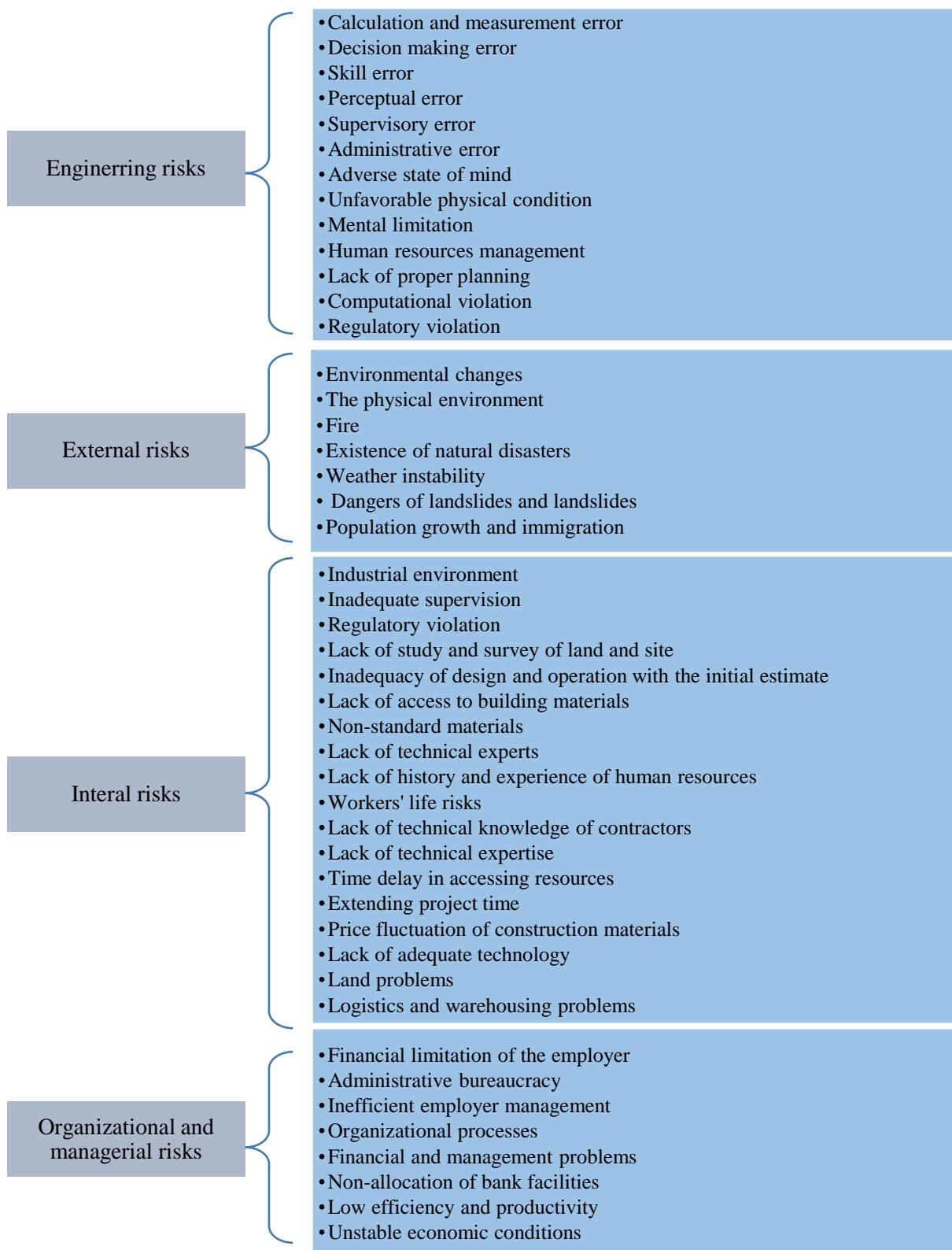
and monitoring are the five stages. Five elements are suggested by Baker et al. (1999) for effective risk management: 1) The non-experts' contact on the topic of risk and risk management is sufficient; 2) The time period is lengthy enough to carry out an extensive management of risk. 3) the payment a risk analyst receives for producing an accurate and adequate risk estimate. 4) contentment with the way your business handles risk. 5) You can improve the way your business handles risk. In essence, risk management solutions typically entail avoiding the risk, minimizing the risk's negative effects, shifting the responsibility to a third party, and accepting some or all of the implications of a particular risk, according to Chakabva and Tengeh (2023). It should be emphasized that risk management does not aim to totally eliminate an organization's business hazards. The process is focused on identifying, measuring, and controlling risks in order to reduce potential repercussions (Rampini et al., 2019).

### **3. Method**

The purpose of this research is to identify the factors which may have positive effects on risk management in civil engineering. Interviews are the most common method for gathering opinion and behavioral data, especially when a complex or highly sensitive topic is involved or when in-depth information is required (Li and Zhang, 2022). For comprehensive results, the research conducted an interview with three experts in the field of civil engineering with more than fifteen years of experience that was contacted through email for an interview about this topic. The interview was conducted to ask about the types of risk in process of construction which may civil engineer and construction firms also insurance companies faced in the construction industry. According to the interviewees, they were asked to name the risks that civil engineers, construction companies and insurance companies may incur.

### **4. Findings**

According to the obtained results, the interviewees have pointed out different risks in the process of construction that may be faced by civil engineers, construction firms, and insurance companies in the construction industry. Based on the responses of the interviewees, the identified risks are divided into the categories of external and internal environments, as well as engineering, organizational, and management. The external environment refers to a wide area outside the scope of civil engineering control, which includes the concepts and factors of the legal, social, economic, cultural, and moral systems of society. This environment also includes climatic, geographical, and international conditions. The external environment is the main source of risks that civil engineers incur in construction projects. The internal environment refers to the internal scope of the project and the company, which is controlled by the project owners and civil engineers. Engineering risks and organizational and management risks are occupational and internal risks, some of which are affected by the risks of the external environment. Figure (2) illustrates the findings of this research based on qualitative data analysis.



**Figure 2:** Risk management aspects



## 5. Conclusion

This paper presents risk management that affects civil engineering in four further sections: engineering, external, internal, managerial, and organizational, to better address the current research goal. Through the complex, interdisciplinary, and difficult process of managing projects and creating new products, risk management seeks to maximize the likelihood of success. As a result, it is essential to any corporate environment since risk influences how procedures turn out and is crucial to ensuring the attainment of strategic goals. As a result, information that is factual, current, pertinent, accurate, and intelligible must serve as the foundation for risk management. Future scenarios should be considered in risk assessments together with historical and present data. The framework and procedure for risk management within the organization ought to incorporate these ideas.

The research results have identified the main causes of accidents that may pose a risk. The identification of these factors can be used in order to formulate a strategy for the selection of civil engineers, construction technology, construction materials, employers, and contractors, as well as insurance companies. In this research, 15 engineering, 6 external, 18 internal, and 8 organizational and managerial aspects of risk management have been identified through interviews.

Any project may be subject to risk. The project manager must be aware of the consequences of the risk, considering the factors of time and cost. After identifying and evaluating the risks, the options available to prevent their occurrence are determined. In addition to selecting corrective measures for risks affecting the project, positive opportunities may also emerge from these risks. In fact, responding to risk means preventing risk, transferring risk, reducing risk, and accepting risk, which depends on its nature. Avoiding risky activities seems to mean avoiding risk. Although this is not always possible, it is the easiest way to deal with risk. In simpler words, controlling that part of the project that may be exposed to new risks and threaten the entire project is risk prevention itself. There are different ways to transfer the risk of the project: buying insurance, using a contract that has a fixed price instead of a contract with a single price, and completely removing the terms of guarantee and warranty.

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*November 28, 2023 Helsinki, Finland*

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